CLAIMS

1.   A method of detecting one of a set of preamble sequences in a spread signal comprising the steps of:

(a) correlating the received spread signal with sequences of a first orthogonal Gold code (OGC) set in accordance with a first fast transform to provide a preamble signal;

(b) correlating the preamble signal with the set of preamble sequences in accordance with a second fast transform to generate a set of index values;

(c) forming a decision statistic based on the set of index values; and

(d) selecting, as the detected one of the set of preamble sequences, a preamble sequence corresponding to the decision statistic.

2.   The invention as recited in claim 1, wherein, for step (a), the first fast transform method is a fast orthogonal Gold code transform (FOGT) comprising the steps of

1) multiplying the received spread signal with a first sequence vector and a forward permutation vector to generate a permuted sequence signal, wherein:

the first OGC set is generated from the first sequence vector and a cyclic shift matrix of a second sequence vector, and the forward permutation vector maps between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard sequences; and

2) applying the fast Hadamaard transform to the permuted sequence signal to generate a set of correlated signals the preamble signal selected as one of the set of correlated signals based on a predetermined decision criterion.

3.   The invention as recited in claim 1, wherein:

for step (b), the set of preamble sequences are selected from a second OGC set formed from first and second sequence vectors, the second OGC set generated from the first sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

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5   the second fast transform is a fast orthogonal Gold code transform (FOGT)

6 comprising the steps of

7   1) multiplying the preamble signal with a first sequence vector and a

8   forward permutation vector to generate a permuted preamble signal, the forward

9   permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of

10   Walsh-Hadamaard sequences, and

11   2) applying the fast Hadamaard transform to the permuted preamble signal

12   to generate the set of index values.

1   4.   The invention as recited in claim 1, wherein, for step (b), the set of

2 preamble sequences are selected from set of Walsh-Hadamaard sequences, and the second

3 fast transform is a fast Hadamaard transform.

1   5.   The invention as recited in claim 1, wherein, for step (a), the received

2 spread signal is a burst of a random-access channel in a code-division, multiple-access

3 communication system.

1   6.   The invention as recited in claim 1, wherein step (c) comprises the steps

2 of:

3   1) forming an initial decision statistic based on the relative maximum index of the

4 set of index values;

5   2) selecting the signal generated by the preamble sequence combined with the

6 preamble signal corresponding to the initial decision statistic;

7   3) adjusting, in one or more of amplitude and phase, the signal selected in step 2);

8 and

9   4) forming the decision statistic based on the adjusted signal.

1   7.   The invention as recited in claim 6, wherein step (c3) adjusts the selected

2 signal by estimating a channel response from the preamble signal, forming a de-rotation

3 signal from the preamble signal, and combining the de-rotation signal with the preamble

4 signal for coherent sequence detection.

1   8.   The invention as recited in claim 6, wherein step (c2) employs the initial

2   decision statistic to locally generate a corresponding preamble sequence, the locally

3   generated preamble sequence being combined with the preamble signal for coherent

4   sequence detection.

1   9.   A method of detecting one of a set of preamble sequences in a spread

2   signal comprising the steps of:

3   (a) correlating the received spread signal with a set of orthogonal sequences to

4   provide a preamble signal;

5   (b) correlating the preamble signal with one or more preamble sequences of an

6   orthogonal Gold code (OGC) set in accordance with a fast transform to generate a set of

7   index values;

8   (c) forming a decision statistic based on the set of index values; and

9   (d) selecting, as the detected one of the set of preamble sequences, a preamble

10   sequence corresponding to the decision statistic.

1   10.   The invention as recited in claim 9, wherein:

2   for step (b), each preamble sequence is selected from the OGC set formed from

3   first and second sequence vectors, wherein the OGC set is generated from the first

4   sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

5   the fast transform is a fast orthogonal Gold code transform (FOGT) comprising

6   the steps of

7   1) multiplying the preamble signal with a first sequence vector and a forward

8   permutation vector to generate a permuted preamble signal, the forward permutation

9   vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard

10   sequences; and

11   2) applying the fast Hadamaard transform to the permuted preamble signal to

12   generate the set of index values.

1   11.   A preamble detector for detecting one of a set of preamble sequences in a

2 spread signal, the preamble detector comprising:

3   a first correlator correlating the received spread signal with sequences of a first

4 orthogonal Gold code (OGC) set in accordance with a first fast transform to provide a

5 preamble signal;

6   a second correlator correlating the preamble signal with the set of preamble

7 sequences in accordance with a second fast transform method to generate a set of index

8 values;

9   a circuit forming a decision statistic based on the set of index values; and

10   a selector selecting, as the detected one of the set of preamble sequences, a

11 preamble sequence corresponding to the decision statistic.

1   12.   The invention as recited in claim 11, wherein the first fast transform is a

2 fast orthogonal Gold code transform (FOGT), the first OGC set is generated from a first

3 sequence vector and a cyclic shift matrix of a second sequence vector, and the forward

4 permutation vector maps between i) the cyclic shift matrix and ii) a matrix of Walsh-

5 Hadamaard sequences; and wherein:

6   the first correlator comprises:

7   a multiplier multiplying the received spread signal with the first sequence

8   vector and a forward permutation vector to generate a permuted sequence signal;

9   and

10   a combiner applying the fast Hadamaard transform to the permuted

11   sequence signal to generate a set of correlated signals, the preamble signal

12   selected as one of the set of correlated signals based on a predetermined decision

13   criterion.

1   13.   The invention as recited in claim 11, wherein:

2   the set of preamble sequences is selected from a second OGC set formed from

3 first and second sequence vectors, the second OGC set generated from the first sequence

4 vector and a cyclic shift matrix of a second sequence vector; and the second fast

5   transform is a fast orthogonal Gold code transform (FOGT); and wherein:

6   the second correlator comprises:

7   a multiplier multiplying the preamble signal with a first sequence vector

8   and a forward permutation vector to generate a permuted preamble signal, the

9   forward permutation vector mapping between i) the cyclic shift matrix and ii) a

10   matrix of Walsh-Hadamaard sequences, and

11   a combiner applying the fast Hadamaard transform to the permuted

12   preamble signal to generate the set of index values.

1   14.   The invention as recited in claim 11, wherein the set of preamble

2   sequences is selected from a set of Walsh-Hadamaard sequences, and the second fast

3   transform is a fast Hadamaard transform.

1   15.   The invention as recited in claim 11, wherein the received spread signal is

2   a burst of a random-access channel in a code-division, multiple-access communication

3   system.

1   16.   The invention as recited in claim 11, wherein the circuit forming the

2   decision statistic comprises:

3   a first magnitude detector forming an initial decision statistic based on the relative

4   maximum index of the set of index values;

5   a signal selector selecting the signal generated by the preamble sequence

6   combined with the preamble signal corresponding to the initial decision statistic;

7   a coherent detector adjusting, in one or more of amplitude and phase, the signal

8   selected in step 2); and

9   a second magnitude detector forming the decision statistic based on the adjusted

10   signal.

1   17.   The invention as recited in claim 16, wherein the coherent detector

2   includes a channel estimator for i) estimating a channel response from the preamble

3   signal, and ii) forming a de-rotation signal from the preamble signal, and a combiner for

4 combining the de-rotation signal with the preamble signal for coherent sequence

5 detection.

1   18.   The invention as recited in claim 16, wherein the coherent detector

2 includes a sequence generator, the sequence generator employing the initial decision

3 statistic to locally generate a corresponding preamble sequence; and a combiner

4 combining the locally generated preamble sequence with the preamble signal for coherent

5 sequence detection.

1   19.   The invention as recited in claim 11, wherein the preamble detector is

2 embodied in an integrated circuit.

1   20.   A preamble detector for detecting one of a set of preamble sequences in a

2 spread signal comprising the steps of:

3   a first correlator correlating the received spread signal with a set of orthogonal

4 sequences to provide a preamble signal;

5   a second correlator correlating the preamble signal with one or more preamble

6 sequences of an orthogonal Gold code (OGC) set in accordance with a fast transform to

7 generate a set of index values;

8   a circuit forming a decision statistic based on the set of index values; and

9   a selector selecting, as the detected one of the set of preamble sequences, a

10 preamble sequence corresponding to the decision statistic.

1   21.   The invention as recited in claim 20, wherein:

2   each preamble sequence is selected from the OGC set formed from first and

3 second sequence vectors, wherein the OGC set is generated from the first sequence vector

4 and a cyclic shift matrix of a second sequence vector and the fast transform is a fast

5 orthogonal Gold code transform (FOGT); and wherein

6   the second correlator comprises:

7   a multiplier multiplying the preamble signal with a first sequence vector and a

8 forward permutation vector to generate a permuted preamble signal, the forward

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9   permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-

10   Hadamaard sequences; and

11   a combiner applying the fast Hadamaard transform to the permuted preamble

12   signal to generate the set of index values.

1   22.   The invention as recited in claim 20, wherein the preamble detector is

2   embodied in an integrated circuit.

1   23.   A computer-readable medium having stored thereon a plurality of

2   instructions, the plurality of instructions including instructions which, when executed by

3   a processor, cause the processor to implement a method of detecting one of a set of

4   preamble sequences in a spread signal, the method comprising the steps of:

5   (a) correlating the received spread signal with sequences of a first orthogonal

6   Gold code (OGC) set in accordance with a first fast transform to provide a preamble

7   signal;

8   (b) correlating the preamble signal with the set of preamble sequences in

9   accordance with a second fast transform to generate a set of index values;

10   (c) forming a decision statistic based on the set of index values; and

11   (d) selecting, as the detected one of the set of preamble sequences, a preamble

12   sequence corresponding to the decision statistic.

1   24.   The invention as recited in claim 23, wherein, for step (a), the first fast

2   transform method is a fast orthogonal Gold code transform (FOGT) comprising the steps

3   of

4   1) multiplying the received spread signal with a first sequence vector and a

5   forward permutation vector to generate a permuted sequence signal, wherein:

6   the first OGC set is generated from the first sequence vector and a cyclic

7   shift matrix of a second sequence vector, and the forward permutation vector

8   maps between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard

9   sequences; and

10   2) applying the fast Hadamaard transform to the permuted sequence signal to

11   generate a set of correlated signals, the preamble signal selected as one of the set of

12   correlated signals based on a predetermined decision criterion.

1   25.   The invention as recited in claim 23, wherein:

2   for step (b), the set of preamble sequences are selected from a second OGC set

3   formed from first and second sequence vectors, the second OGC set generated from the

4   first sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

5   the second fast transform is a fast orthogonal Gold code transform (FOGT)

6   comprising the steps of

7   1) multiplying the preamble signal with a first sequence vector and a

8   forward permutation vector to generate a permuted preamble signal, the forward

9   permutation vector mapping between i) the cyclic shift matrix and ii) a matrix of

10   Walsh-Hadamaard sequences, and

11   2) applying the fast Hadamaard transform to the permuted preamble signal

12   to generate the set of index values.

1   26.   A computer-readable medium having stored thereon a plurality of

2   instructions, the plurality of instructions including instructions which, when executed by

3   a processor, cause the processor to implement a method of detecting one of a set of

4   preamble sequences in a spread signal, the method comprising the steps of:

5   (a) correlating the received spread signal with a set of orthogonal sequences to

6   provide a preamble signal;

7   (b) correlating the preamble signal with one or more preamble sequences of an

8   orthogonal Gold code (OGC) set in accordance with a fast transform to generate a set of

9   index values;

10   (c) forming a decision statistic based on the set of index values; and

11   (d) selecting, as the detected one of the set of preamble sequences, a preamble

12   sequence corresponding to the decision statistic.

1   27.   The invention as recited in claim 26, wherein:

2   for step (b), each preamble sequence is selected from the OGC set formed from

3   first and second sequence vectors, wherein the OGC set is generated from the first

4   sequence vector and a cyclic shift matrix of a second sequence vector; and wherein

5   the fast transform is a fast orthogonal Gold code transform (FOGT) comprising

6   the steps of

7   1) multiplying the preamble signal with a first sequence vector and a forward

8   permutation vector to generate a permuted preamble signal, the forward permutation

9   vector mapping between i) the cyclic shift matrix and ii) a matrix of Walsh-Hadamaard

10   sequences; and

11   2) applying the fast Hadamaard transform to the permuted preamble signal to

12   generate the set of index values.

1   28.   A transmitter in a code-division, multiple access communication system

2   generating data including a preamble sequence in a random access, burst channel, the

3   transmitter comprising a spreader combining the preamble sequence with a selected one

4   of a first set of orthogonal Gold code sequences.

1   29.   The invention as recited in claim 28, wherein the preamble sequence is a

2   selected one of a second set of orthogonal Gold code sequences.